July 18, 2008

MEMORANDUM

TO: Erick Neher; DEQ Idaho Falls Regional Office Administrator

FROM: Charlie Mazzone, DEQ Idaho Falls Regional Office Water Quality Engineer

SUBJECT: Permit Renewal Staff Analysis: Mack's Inn Wastewater Treatment and Reuse Facility; LA-000057-3

1.0 Purpose

The purpose of this memorandum is to satisfy the requirements of IDAPA 58.01.17.400.04 *Application Processing Procedure – Contents of the Staff Analysis* for issuing wastewater reuse permits. Specifically, this staff analysis shall briefly state the principal facts and the significant questions considered in preparing the permit conditions, and a summary of the basis for the conditions with references to applicable requirements and supporting materials.

2.0 Process Description

The Mack's Inn wastewater treatment facility provides primary and secondary lagoon treatment of wastewater, wastewater storage, and wastewater disinfection. After disinfection, wastewater is either mechanically evaporated, land applied to 58 acres, or applied to two six acre parcels with a snow generation (Snowfluent) process.

Cells (lagoons) A and B are aerated, and Cells 3 and 4 serve as settling and storage ponds. Wastewater influent is screened, then flows to Cell A, Cell B (with valves allowing influent flow directly to Cell B if desired), then to Cells C and D for storage. Wastewater in Cell C can pass through the chlorine contact chamber for disinfection prior to disposal. Class C wastewater effluent (IDAPA 58.01.17.600.07 et. seq.: *Specific Permit Conditions – Direct Use of Municipal Reclaimed Wastewater)* is chlorine disinfected to 23 organisms per 100 mL (maximum) before the wastewater is land applied, evaporated, or applied in the snowfluent process.

Table 2.1 Lagoon Data

Lagoon	Description	Volume (gallons)
Cell A	Part time partial mix aeration *	2,700,000
Cell B	Part time partial mix aeration *	2,700,000
Cell C	Facultative / storage	7,500,000
Cell D	Facultative / storage	4,100,000
Total		17,000,000

* Aeration time is adjusted to meet 2.0 ppm dissolved oxygen at cell transfer to facultative storage.

Both irrigation and snowfluent are applied to US Forest Service (USFS) land under a special use permit. Vegetation consists of native trees and grasses. Timber harvesting is not allowed except for removal of saplings, trees hindering the irrigation spray zone, and trees stressed by snowfluent overburden.

The land application irrigation system is PVC pipe. An 8 inch diameter main line feeds lateral lines spaced 80 feet apart. Sprinkler heads are spaced 50 feet apart on laterals. Design flow is 1,000 gallons per minute.

Table 2.2 Slow Rate Irrigation Schedule

	May	June	July	August	September	Totals
Wastewater applied (MG)	2.84	5.67	8.4	8.4	2.84	28.15
Wastewater applied (inches/wk)	0.41	0.84	1.20	1.20	0.42	-
Required days*	4	7.8	12	12	4	40
Schedule (days/week)	1	2	3	3	1	-
Calendar days	31	30	31	31	30	153

* The irrigation pump averages 1,000 gallons per minute; the irrigation schedule is based on a 12 hour irrigation period.

The snowfluent system pumps effluent at 200 gallons per minute to two sprays towers; each tower is associated with a six acre application unit. The system design allows for the permitted volume of 16 million gallons of wastewater to be processed into snow in approximately 1,500 operating hours; 25% estimated sublimation results in 12 million gallons wastewater loading and 4 million gallons lost to sublimation.

The evaporator is located between Cells A and B; wastewater is pulled from storage Cell C. A metered 100 gallons per minute pump can process 5 million gallons at normal operating hours (8 hours per day) during the May through September operating period. Evaporation efficiency is difficult to quantify due to dynamic meteorological conditions and difficult measurement techniques, but the facility estimates 25 percent to 50 percent efficiency, for a range of 1.25 to 2.5 MG evaporated per year. However, the evaporator is permit limited by allowable months of operation, and not limited by volume of wastewater.

Summary of Events

Events relevant to this permitting action are summarized below.

1973: the *Macks Inn Sewerage Systems Evaluation and Proposals* recommends building a municipal wastewater treatment system.

1982: facility construction.

September 1983: the initial O&M inspection was conducted by the Department of Health and Welfare after one year of operation. No wastewater had been land applied at that time. The facility includes 2 aerated lagoons (0.98 acres each), one 2.25 acre storage lagoon, a chlorine contact chamber, and 80 acres designated for application. The population served is approximately 700 connections, but only 200 connections in winter. The annual average daily flow rate is 3,000 gallons per day; weekend flow approaches 6,000 gallons per day.

October 1986: the facility conducts its initial land application of effluent.

May 1988: an inspection report raises concern over lack of storage for increased winter flow.

1989: Cell 4 (lagoon) is constructed. The cell volume is 4.1 million gallons, and will be used for storage.

1990: the initial permit is issued for the facility. 15 million gallons per year are land applied to 58 acres.

1996: a permit modification increases the allowable land application to 27.5 million gallons annually.

1998: facility modifications: headworks with screen, a chlorine chamber evacuation pump, and upgrades to the aeration system.

2000: the permit renewal increases land application volume to 28.35 million gallons per year (MGY), and incorporates Snowfluent operations at 16 MGY to 12 acres; the facility total permitted effluent volume is 44.35 MGY. A 1997 facility planning study estimated year 2000 wastewater effluent volume at 42.4 MGY.

2004: the DEQ approves May through October use of an evaporator system at the facility. Mechanically evaporated wastewater is estimated at 1.25 to 2.5 million gallons per year, or 25% to 50% of an estimated 5 million gallons processed through the evaporator.

3.0 Site Characterization

3.1 Climate

Mack's Inn is 6,420 feet in altitude, and is characterized by:

- 36.77 inches of average annual precipitation (USDA SCS Soil Survey of Fremont Co., 1948-90);
- Less than 110 frost free days per year (May 28 to September 14 is considered frost free in Rexburg, Madison County, elevation 4925);
- 17.17 inches average annual (Class A) pan evaporation (4.90 in. June + 6.58 in. July + 5.69 in. August + 0.0 all other months);
- a 7.6 mph (mean) southerly prevailing wind (Rexburg data); and,
- 11/10 inch of precipitation for the 5 year, 6 hour event frequency.

3.2 Soils

The facility contains Perfa and Bootjack soil types (1997 Facility Planning Study, Amendment 3, page 18). Perfa is a very deep, moderately well drained sandy loam. Bootjack is a very deep, poorly to somewhat poorly drained silt loam over sand.

3.3 Ground Water

The facility 1999 Technical Report cites a 1983 study of the east Snake River Basin by D.J. Parliman for southerly groundwater flow and estimated hydraulic gradient of 0.0033 feet per foot. No site specific measurements are available; the monitoring wells have not been surveyed and marked to correspond to a common datum. The groundwater most likely flows towards the Henrys Fork River, less than 0.5 miles south of the facility. The facility is required, with this permit renewal, to submit ground water contour maps with each annual report. Staff recommends surveying the wells in support of mapping.

Ground water depth was reported in the spring of 1995: the four monitoring wells in the irrigated unit varied from 18 to 25 feet below ground surface. Snowfluent acreage ground water depth has not been reported.

Transmissivity at the facility is unknown.

The sampling requirement for COD has been eliminated due to the low historic loading rates (individual sampling analyses range from 0.4 to 2.8 lb/acre*day).

3.4 Surface Water Considerations

There is no surface water within ¼ mile of the facility. The nearest surface water is the Henrys Fork, which lies 0.38 miles south of the Snowfluent west spray field. The irrigated unit and the lagoons are 0.41 mile or more from the Henrys Fork.

The facility lies outside of the 100 year flood plain.

3.5 Buffer Zones and Disinfection Level

The facility reports the following buffer zones:

1. zero feet between wastewater application sites and areas accessible to the public (via USFS roads);
2. greater than ¼ mile to any:
    - public drinking water supply sources;
    - private drinking water supply sources;
    - public or private gathering areas;
    - dwellings;
    - surface water;
    - wells;
    - springs; and,
    - wetlands.

Given the above conditions, the facility must disinfect to a minimum level of 23 coliform bacteria organisms per 100 mL (Class C effluent and buffer zone scenario G). The disinfection level is determined in this case by the forest service road passing along the treatment fields, creating zero feet to public access, and therefore necessitating the Class C effluent.

Scenario G, as described in the DEQ Reuse Guidance, recommends a three wire pasture fence around the land application unit and posting in each corner and every 500 feet along the perimeter with "Sewage Effluent Application – Keep Out". Due to the rural nature of the Macks Inn facility, which is bordered by National Forest Service land, there is little public traffic; therefore, the fields are unfenced. However, a chain link fence along the US Forest Service road prevents access from the road to the irrigated fields. The snowfluent application area is posted with warning signs. Finally, the recent platting of Big Spring Estates subdivision on the north side of the facility has necessitated a three wire, lay down fence along the facility border and the subdivision – a length of 387 feet – which will also be posted with four warning signs, including two at the lot corners.

To protect the acreage available to the Macks Inn facility for spray irrigation, the Big Springs Estates subdivision was approved with the following conditions which remove buffer distance impact on the spray fields:

> *The deeds for lots three and four shall be amended to include the following Department of Environmental Quality required setbacks from the Macks Inn Wastewater treatment facility operational boundary (spray fields):*
>
> - *The lot 4 deed shall incorporate a 300 feet inhabited building setback and prohibit a private well;*
> - *The lot 3 deed shall incorporate a 500 feet private well setback.*

4.0 Historic and Proposed Site Loading, Projected Environmental Impacts, and Related Permit recommendations

4.1 Wastewater Quality and Flow

The Mack's Inn wastewater treatment facility has a design average influent flow of 0.2 million gallons (MG) per day, based on 85% BOD removal in the aerated Cells A and B.

Metered influent flow data exists for the years shown in Figure 4.1. Although influent volumes are increasing steadily, the year 2006 influent volume of 33.9 MG may be higher than typically expected due to inflow resulting from an excavated sewer line, resulting in groundwater inflow.

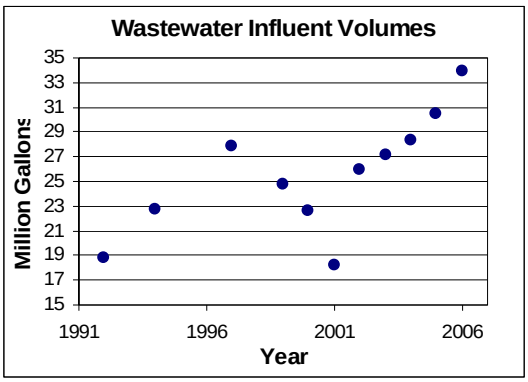

Figure 4.1 Wastewater Influent Volumes

The facility is permitted to remove 44.35 MG of wastewater (28.35 MG irrigated + 16 MG snowfluent), in addition to 1.25 to 2.5 MG evaporated; the total is approximately 12 MG disposal capacity beyond the 2006 influent volume.

Influent quality has not been analyzed at the facility.

4.2 Loading Rates – General

Figure 4.2 shows irrigated hydraulic loading for the Macks Inn facility.

Total hydraulic loading per snowfluent tower is depicted in Figure 4.3. The two snowfluent towers apply twice the total gallons graphed. Note that the totals represent both the volume of wastewater treated by each snowfluent tower as well as the hydraulic loading after 25% sublimation of snow.

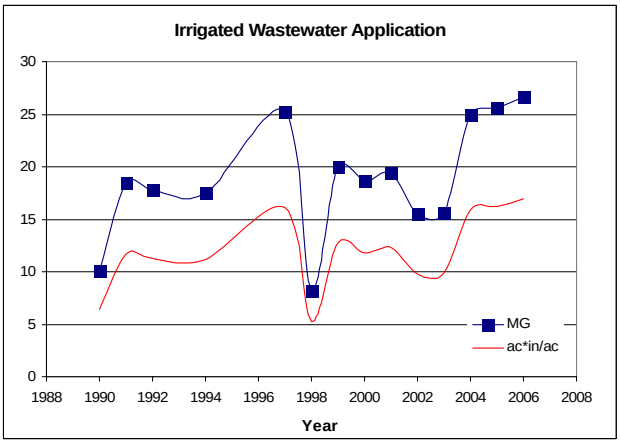

Figure 4.2 Irrigation Hydraulic Loading

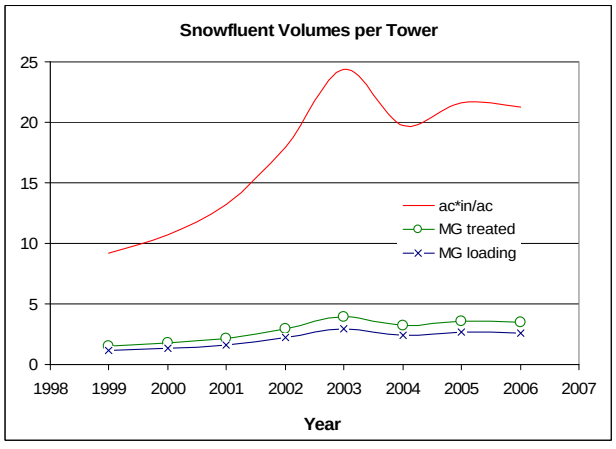

Figure 4.3 Per Tower Snowfluent Data

Macks Inn employs silviculture for wastewater and nutrient uptake. Native grasses and lodgepole pine inhabit the application sites. A US Forest Service special use permit exists for both the irrigated and snowfluent acreage. Trees which inhibit irrigation or which are overburdened by the snowfluent are harvested; otherwise, trees have not been harvested for lumber, nor native grasses harvested, so nutrient removal has not been conducted to date.

Though little data exists for silvicultural management, the EPA *Process Design Manual – Land Treatment of Municipal Wastewater Effluents* suggests hydraulic loading rates based on site evaluation. The Macks Inn facility appears to fit in the 1.0 to 1.5 inches per acre per week (in./ac*wk) hydraulic loading category; additional site analysis may increase the site to the 2.0 to 2.5 in./ac*wk category. The EPA Manual also suggests nitrogen loading of 200 to 250 lb/ac*yr is within reason for established conifers with understory grasses. Further, perennial grasses, as existent at the Macks Inn site, are well suited for nitrogen, phosphorus, and potassium uptake.

Table 4.1 Loading Rates at Macks Inn

Parameter	**Loading**		
	Recommended/**Permit Limit**	Irrigated Actual	Snowfluent Actual
Wastewater loading rate	1.0 to 1.5 inches per week; **18 inches per acre year irrigated; 36.8 in./ac*yr snowfluent**.	0.41 to 1.20 in./week; less than 17 in./ac*yr year	Weekly data is N/A; less than 25 in./ac*yr
Nitrogen	200 to 250 lb/ac*yr (EPA); **150 lb/ac*yr or 150% of crop uptake**.	Less than 1.5 lb/ac*d; less than 234 lb/ac*yr.	Less than 0.7 lb/ac*d; less than 128 lb/ac*yr.
COD	**50 lb/ac*d irrigated; 25 lb/ac*d snowfluent**	Less than 2.5 lb/ac*d	Less than 3 lb/ac*d
Phosphorus[1]	< 125% of crop uptake	12 lb/ac*yr	28 lb/ac*yr (104% of crop uptake)

1: EPA estimates 27 lb of phosphorus accumulation in biomass per acre of trees.

4.3 Wastewater Constituent Loading

Constituent loadings are listed in Table 4.1, above.

Previous analyses of the facility have expressed concern for phosphorus buildup in the snowfluent area soil, or leaching at the snowfluent sites due to the high hydraulic loading rates. Monitoring has not indicated phosphorus buildup or breakthrough (Figures 4.4 and 4.5).

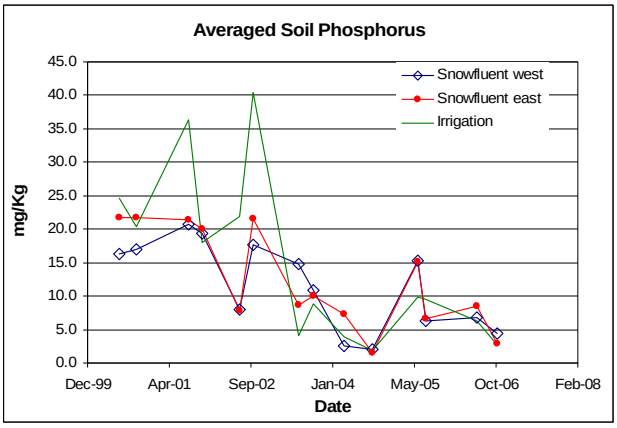

Figure 4.4 Soil Phosphorus

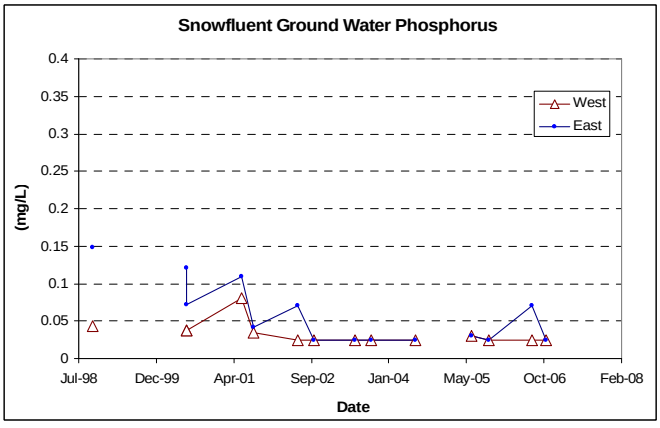

Figure 4.5 Snowfluent Ground Water Phosphorus

Historic nitrate levels in soil and ground water are shown in Figures 4.6, 4.7, and 4.8.

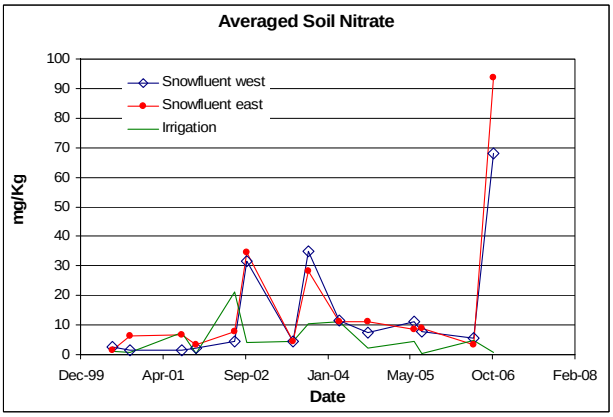

Figure 4.6 Historic Soil Nitrate

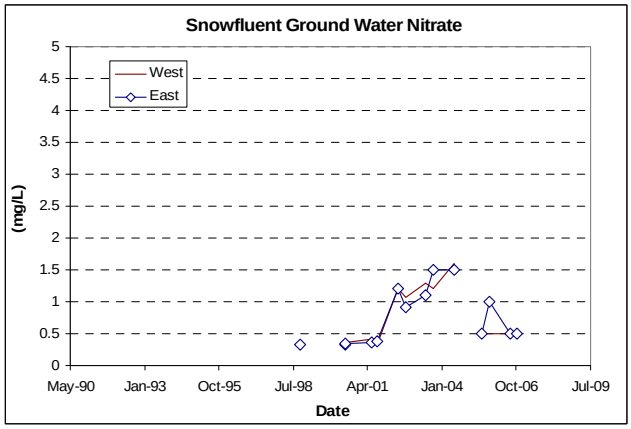

Figure 4.7 Snowfluent Units Ground Water Nitrate

Ground water nitrate levels are analyzed twice per year, and do not indicate any ground water standard violations.

4.4 Crop Nitrogen Requirements

The EPA *Process Design Manual – Land Treatment of Municipal Wastewater Effluents* suggests nitrogen loading of 200 to 250 lb/ac*yr is within reason for established conifers with understory grasses. Further, perennial grasses, as existent at the Macks Inn site, are well suited for nitrogen, phosphorus, and potassium uptake. See Table 4.1 for nitrogen loading rates.

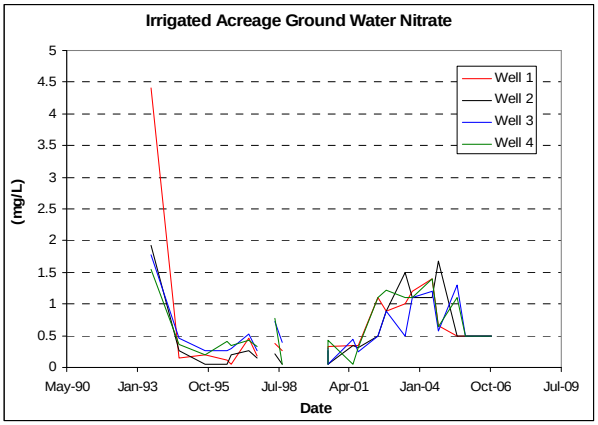

Figure 4.8 Irrigated Ground Water Nitrate

4.5 Hydraulic Loading

4.5.1 NGS Hydraulic Loading

The Mack's Inn facility utilizes snow production during the non-growing season.

4.5.2 GS Hydraulic Loading

The Mack's Inn facility employs irrigation and evaporation during the growing season,.

4.6 Cropping/Silviculture Plan

The DEQ recommends that Macks Inn develop a plan to address silviculture. Although timber harvesting is not allowed by the Forest Service, it may be beneficial to the facility to consider long term management of the wastewater application area, considering tree age to maturity, and therefore useful life span of the area. If trees will eventually be harvested (at maturity, for example), the following items may influence current and future management.

Harvesting

- Some harvesting techniques may impair soil properties.
- Whole tree harvesting removes accumulated nutrients from the facility, whereas traditional stem harvesting may remove as little as 30 or 40% of nitrogen.

- Understory perennial grasses provide substantial nutrient uptake.

Tree Age Distribution

- Trees reduce nutrient uptake at maturity.
- If all the management unit's trees are of similar age, then complete harvesting of all mature trees will reduce the unit's nutrient uptake potential.
- Selective harvesting may maintain a desirable age distribution.
- Culling saplings discourages desirable age distribution.

A collaborative inspection by the facility operator, the USFS, and the DEQ would help address long term management, and is included as a *Required Activity* in Part E of this permit renewal.

5.0 Site Management and related permit recommendations

5.1 Plan of Operation (*Plan*, Operation and Maintenance Plan, or O&M Plan)

The DEQ has the 1982 *Plan* on file. Changes that have occurred since 1982 include snow generation, mechanical evaporation, and lagoon storage capacity. The permit contains a Compliance Activity for updating the *Plan* to reflect changes at the facility since the last *Plan* revision.

5.2 Odor Management Plan (Nuisance Odor Plan)

Although odor management is briefly discussed in Chapter Six of the O&M Plan – *Trouble Shooting the Sewage Lagoons*, and Chapter 13 – *Maintenance,* the procedures should be more extensively reviewed and extracted to stand alone as a separate document and chapter of the *Plan*. See Section 6.2 *Required Activities.*

5.3 Grazing Plan

The Mack's Inn facility disinfects to Class C effluent. Grazing is discouraged on municipal wastewater applied sites, but is allowed if it follows a DEQ approved grazing plan. Macks Inn does not have an approved grazing plan. The staff recommends that grazing not be allowed at this location to prevent premature failure of the native vegetation treatment sites.

5.4 Waste Solids (Sludge) Management Plan

Due to lagoon repair, Macks Inn has established procedures for sludge management. The procedures should indicate how the requirements of Permit Condition I.5 are met, and be incorporated into the Plan of Operation.

5.5 Buffer Zones and Wellhead Protection

The facility appears to meet the buffer zone guidlines for Class C effluent (less than 23 coliform organisms per 100 mL). See section 3.5 of this analysis for more information.

5.6 Lagoons: Integrity, Sludge Depths, and Seepage Tests

Sludge depth monitoring and action depths should be part of the Waste Solids (Sludge) Management Plan.

All lagoons should be seepage tested every five years to determine liner integrity. In order to comply with Permit Section I.6, each lagoon should be tested again before the next permit

renewal application. The seepage test results should be included with the permit renewal package at that time.

6.0 Status of current activities & recommended activities for the new permit

6.1 Current Activities

The following activities were required by the previous facility permit.

Irrigation Schedules were to be reviewed by a qualified professional and revised as necessary. A review has not been submitted to the DEQ. See Section 6.2 *Required Activities.*

A *Plan of Operation* was required to be submitted to the DEQ; however, the DEQ has only the 1982 Operations and Management Plan on file, and requests the Plan be reviewed and updated according to the Required Activities of this permit renewal. See Section 6.2 *Required Activities.*

Seepage rate testing was required, completed, and passed the DEQ criteria.

IDAPA 58.01.16.202 *Classification of Public Wastewater Systems* requires that all systems be classified based on indicators of potential health risks. Further, IDAPA 580.01.16.203 *Public Wastewater System Operator Licensure Requirements* requires that each system be under the responsible charge of an operator who holds a valid license equal to or greater than the classification of the system.

The Mack's Inn facility is a Class 1 wastewater treatment and a Class 3 wastewater collection facility. Operator Dan Lostutter is a qualified operator holding Class 2 treatment, Class 4 collection, and land application operator licenses.

6.2 Required Activities

Proposed draft permit Section E – *Compliance Schedule for Required Activities* prescribes compliance activities to be completed by the facility, and their respective completion deadlines. The compliance activities are described below, according to the compliance activity number.

CA-057-01: Submit a **Plan of Operation** manual update. The current Plan of Operation (*Plan*), also known as the O&M Manual, was written in June of 1982. The *Plan* needs to be updated to reflect current operations. A *Plan of Operation Checklist* is located in the DEQ Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater, page 1-72. The Plan should include irrigation schedules, the Odor Management Plan, the Waste Solids Management Plan, the Runoff Management Plan, and current grazing prohibitions.

CA-057-02: **Irrigation schedules** for the slow rate application should be reviewed by a qualified professional and revised as necessary. The recommended irrigation schedule should be incorporated into the Plan of Operation.

CA-057-03: An **Odor Management Plan** encompasses wastewater treatment systems, reuse facilities, and other operations associated with the facility. The plan should outline specific design considerations, operation and maintenance procedures, and management practices to be employed to minimize the potential for, or limit, odors. The plan should also include procedures to respond to an odor incident if one occurs, including notification procedures.

CA-057-04: Submit a **Well Locations Survey Report** according to requirements of the permit. The report should establish a datum for groundwater contour maps. Currently the facility is unable to establish groundwater elevations for groundwater contour maps required for each ground water sampling event.

CA-057-05: **Seepage tests** should be completed on all lagoons according to the most recent DEQ procedures. Current DEQ procedure calls for seepage testing on all lagoons every five years. See IDAPA 58.01.16.493 for seepage test specifics.

CA-057-06: Submit a **Waste Solids Management Plan** for DEQ review and approval.

CA-057-07: Submit a **Runoff Management Plan** according to the requirements of the permit.

CA-057-08: Conduct a collaborative **silviculture inspection** with the facility operator, the USFS, and the DEQ in order to evaluate long term management of the wastewater application area. Specifically, the inspection should evaluate current and future management practices which may be dictated by the native tree age to maturity, and/or USFS management protocols for action at tree maturity.

Permit Section G – Monitoring Requirements

Permit Section G contains monitoring requirements for the facility. Table 7.1 reorganizes the monitoring requirements according to the medium sampled; the table is intended as an organizational aid only. Note that calculation requirements listed in the Permit Section G *Facility Monitoring Table* are not listed in Table 7.1 – only monitoring requirements are listed. See the Permit for exact descriptions of monitoring and calculations required.

Table 7.1: Monitoring Requirements by Medium

Parameter	Daily	Weekly	Monthly	Annually	Other Frequencies
Wastewater – lagoon effluent	Volume to each HMU	Lab analysis	Lab analysis	Flow meter calibration	
Supplemental irrigation water	Volume to each HMU			1. Flow meter calibration; 2. Backflow testing.	
Ground water				1. Lab analysis; 2. Static water level; 3. Groundwater contour map.	
Soil				Lab analysis	First year of permit lab analysis
Fertilizer				Quantity applied	

Permit Section H – Standard Reporting Requirements

Permit Section H lists the facility reporting requirements. Table 7.2 summarizes the Annual Report requirements which are derived from monitoring. Note that the monitoring requirements are listed across the top of the table, and the Annual Report requirements generated from monitoring constitute the body of the table.

Table 7.2: Annual Report Requirements Derived from Monitoring

Parameter	**Monitoring Requirements**			
	Daily	Monthly	Annually	Other frequencies
Wastewater – lagoon effluent	1. Total volume to each HMU in gal/d, gal/month, gal/yr and in./ac*d, in./ac*month, and in./ac*yr. *2. Calculations (per HMU)*: - nitrogen and phosphorus applied in lb/ac*yr.	Lab analysis results	Flow meter calibration date and results.	
Ground water			1. Water table depths: - below ground surface; - above mean sea level; - contour maps. 2. Lab analysis results.	
Soil			End of growing season lab analysis results.	Permit first and last year lab analysis results.
Fertilizer			Total pounds applied to each HMU/yr. *Calculations*: - nitrogen and phosphorus applied in lb/ac*yr.	

Other Annual Report requirements, as stated in the permit, are:

1. The status of compliance activities.
2. An interpretive discussion of monitoring data with particular respect to environmental impacts by the facility. The report should interpret the monitoring data, including the lab analyses, and discuss any environmental impacts revealed by the data.
3. All laboratory reports containing the sample results for Section G *Monitoring Requirements.*

7.0 Conclusions and Recommendations

The DEQ recommends that the Mack's Inn conduct the new permit required monitoring and report the required data to evaluate system performance, permit compliance, and guarantee that environmental degradation does not occur at the facility.

8.0 Recommendation for Issuance or Denial of Permit

Staff recommends that the attached Municipal Wastewater Reuse Permit be issued. The permit specifies hydraulic loading limits, and establishes monitoring requirements to adequately protect public health and the environment.

9.0 References

USEPA – "Process Design Manual – Land Treatment of Municipal Wastewater Effluents", United States Environmental Protection Agency, September 2006, EPA document No. EPA/625/R-06/016.

USDA – "Soil Survey of Jefferson County, Idaho", United States Department of Agriculture, Soil Conservation Service, December 1979.

Idaho DEQ *Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater:* http://www.deq.idaho.gov/water/permits_forms/permitting/guidance.cfm